ON

GOLD-MINING AND ITS PROSPECTS IN NOVA SCOTIA,

EMBODYING THE RESULTS OF GEOLOGICAL SURVEYS OF THE DISTRICTS OF WAVERLEY AND SHERBROOKE, FOR THE PROVINCIAL GOVERNMENT.

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I.—GENERAL DESCRIPTION OF THE RELATIONS OF THE GOLD-BEARING ROCKS.

The area occupied by the lower Silurian gold-bearing rocks of Nova Scotia has been variously estimated at from 6,000 to 7,000 square miles.† Since these estimates were made, there has been described a series of gneissic rocks, supposed to be the equivalents of the Cambrian and Laurentian,‡ which occupy at least one-half of the area hitherto assigned to the lower Silurian. These rocks are not yet known to be auriferous, although from the discovery of an auriferous band in the lower Laurentian, in Ontario, beneath the great iron deposits,§ there is good reason for the expectation that an auriferous zone will be found in the Nova Scotian gneisses underlying the present gold-bearing series.

I do not suppose that the lower Silurian gold-bearing rocks of Nova Scotia cover a larger area than 3,000 square miles. Gold has been found also in the upper Silurian, which may be exposed over an area of from 500 to 800 square miles, so that the total known area of the gold-bearing rocks of Silurian age probably does not exceed 4,000 square miles.

There is, however, another remarkable source of gold in the conglomerates at the base of the lower carboniferous rocks. It is not surprising that gold should have been discovered resting in the form of worn particles on the Silurian slates which support the oldest of the lower carboniferous conglomerates, or in the lower beds of the oldest conglomerate itself; but it is remarkable that gold should be found near the summit of a bed of conglomerate whose thickness is about 600 ft., and which is separated from the oldest conglomerate of the lower carboniferous series in Nova Scotia by an immense mass of bituminous shales and sandstones. In Cape Breton, gold has been discovered at the summit of a conglomerate occupying this horizon on the peninsula opposite Baddeck.

The occurrence of gold in the carboniferous conglomerates of Nova Scotia, especially at the base of the series, and in the fissures and crevices of the Silurian slates on which they rest, is highly important and suggestive, but too little is known respecting its distribution to make it a subject for description or discussion in this paper. During the ensuing summer its relations will probably be studied with some detail.

The lower Silurian rocks appear to be distributed chiefly on the south-eastern flank of a great gneissoid axis, which extends with some interruptions, hereafter noticed, from Cape Sable to the Gut of Canso, or, throughout the entire length of Nova Scotia. The most important break in the continuity of the gneissoid axis is a profound Silurian valley, averaging twelve miles in breadth, and extending from the Atlantic, at Halifax, to within ten miles of Windsor, near the Basin of Minas (Bay of Fundy). West of this Silurian valley, the gneissoid rocks occur in detached area, of greater or less

* The paper was illustrated by specimens kindly lent by Professor Tennant, consisting of a large number of gold specimens in the matrix from Nova Scotia, Canada, British Columbia, Australia, the West Coast of South America, North Wales, Cornwall, Scotland, and other localities, also some crystals of gold figured in Mawe's "Travels in Brazil."

† The total area of the gold region may be estimated at about 7,000 square miles, and the proclaimed districts do not yet reach a twentieth part of this area.—Dawson, "Acadian Geology," second edition, p. 632.

‡ "Preliminary Report on a Gneissoid Series, underlying the Gold-bearing Rocks of Nova Scotia." By the author.

§ Summary Report of Progress in Geological Investigations. "Geological Survey of Canada, 1869."

extent, to the Gut of Canso. The most important at present of these gneissic areas is situated in the county of Guysborough.

In the Silurian valley between Halifax and Windsor, the gold districts of Lawrencetown, Montague, Waverley, and Renfrew, are situated on the east side of the valley; Mount Uniacke and Hammond Plains on the west side. Around the gneissic nucleus in the county of Guysborough, the districts of Sherbrooke, Wine Harbour, Isaac's Harbour, Country Harbour, and Cochrane's-hill, are symmetrically arranged. The other districts, such as Tangier, Musquodoboit, Oldham, and Fifteen-Mile Stream, bear also a certain relation to gneissic areas, but enough is not known of this relation to admit of description.

The Cambrian gneiss occurs about two and a-half miles to the east of the worked lodes at Waverly, and about the same distance east from Goldenville at Sherbrooke. At Mount Uniacke it is about the same distance to the west. Most of the known gold districts occur in close proximity to gneissic areas, but this arises from the circumstance that denudation has been most active on the more elevated intersections of the anticlinals, and has removed the Silurian strata, thus exposing the underlying gneiss. When comparatively low anticlinals intersect, there is no gneissic exposure. Two sets of main anticlinals intersect one another in Nova Scotia, one set having an easterly and westerly direction, the other at nearly right angles, or a northerly and southerly course. At the intersections of these anticlinals the gold districts are situated, and here, also, where denudation has removed the Silurian strata, the underlying gneisses are exposed, or have been brought to the surface by the great dislocations which accompanied the last, or north and south folding.*

The districts of Waverley and Sherbrooke have been carefully surveyed, and their geological structure worked out with considerable detail. I was engaged in this duty during part of the autumn of 1868 and the summer of 1869, for the Department of Mines, and the maps which illustrate this paper are those which I prepared for the Department, and which, by permission of the Chief Commissioner, I have brought with me.

Waverley and Sherbrooke are types of all the known gold districts in Nova Scotia. One (Waverley) occurs with several others in a Silurian valley between two great exposures of gneissic rocks, the other (Sherbrooke) is one of many arranged round a island of gneiss.

II.—Origin of the Gold.

The results of my surveys do not show any direct relation between the origin of the gold and the gneissic areas. I consider that all the evidence hitherto accumulated in Nova Scotia tends to show that the gold was originally deposited from oceanic waters, and diffused throughout their sediments, especially in beds of quartz. Much of it was, no doubt, subsequently concentrated in intercalated beds of quartz, and in some instances in fissure veins.

There is no evidence to show that intrusive rocks, or veins, or dykes had any share in the introduction of the gold; indeed, I have not yet seen any rocks in Nova Scotia near the gold districts which, upon close examination and study, can be regarded as intrusive rocks. Gold is found and worked in beds of quartz of contemporaneous age with the interstratified slates and quartzites, and in their beds or veins adjacent to beds of quartz, throughout a vertical thickness of 6,000 ft. These beds are worked in one district or another throughout that thickness of strata on anticlinal or synclinal folds.

Waverley and Sherbrooke districts are eighty miles apart in an air line, and yet so uniform is the mineral composition of the series, that certain beds of grit can be identified at these distances, not only by the occurrence of peculiar forms, supposed to be an *Eospongia*, but by their mineral characters.

It must not be supposed, however, that all the worked auriferous lodes of Nova Scotia are contemporaneous beds. I conceive that a large number are intercalated, as subsequently described, and of the contemporaneous auriferous beds many have suffered much modification since first deposited.

III.—Structure of Waverley Gold District.*

The strata at Waverley† are arranged in the form of a long elliptical dome, tilted over to the north. This form was occasioned by the intersection of two great anticlinal folds, one having a course from east to west, the other from north to south. The east and west fold has a slight overturn to the north. At Mount Uniacke the east and west fold has an overturn to the south, which is also the case at Sherbrooke.

The thin contemporaneous beds of auriferous quartz, or lodes, necessarily partook of all the movements to which the strata with which they are associated were subjected; hence, we find the outcrops of the lodes curving round the axis of the tilted east and west anticlinal in the form of long semi-ellipsis, where denudation has exposed the edges of this bed. This distribution of the outcrop of the lodes is of the first importance, and it may be easily illustrated by bending a number of sheets of paper in the form of an arch, to represent the east and west anticlinal, tilting up one extremity to represent one side of the north and south anticlinal, and then cutting off a portion horizontally, to represent the effects of denudation. The exposed edges of the paper will then have the form of long semi-ellipses. It is evident that the outcrop of the lodes will be dependent upon the nature of the intersecting anticlinals, and the extent of denudation to which they have been subjected. Anyone familiar with the forms produced by the intersection of plain and curved surfaces, will readily understand how the mapping of the outcrop of these bedded lodes becomes a question belonging to stratigraphical geology.

In the autumn of 1868, the accompanying map of the Waverley district was prepared, and a lithographed reduction accompanies my report on that district. One of the most important lodes there is the Tudor lode, which was "lost," so to speak, at the point where the continuous line ceases on the map. This lode had yielded 8,727 ounces of gold from 6,972 tons of quartz, in 1865, averaging 1 oz. and 6 dwts. per ton. From a study of the structure of the district, the details of which are given in my official report, I indicated the course of the "lost" Tudor, as represented by the dotted line on the plan. Operations were commenced, late in the autumn of 1868, to discover this lode on the south side of the anticlinal, about 770 feet from the place where its alleged disappearance had occurred. In January, 1870, it had been traced, and in part worked back to the area where it had been "lost," through a distance on the curve of about 1,100 feet, connection with the original lode being broken by a small fault. The mean difference between the ascertained outcrop and the theoretical outcrop is 25 feet 9 inches in 1,100 feet horizontally.

The north lode is also a valuable lode at Waverley. This lode runs parallel to the Tudor on the north side of the anticlinal, and it has also been recently traced, and in part worked, parallel to the Tudor lode on the south side of the anticlinal, through a horizontal distance of 900 feet, the mean difference between the theoretical outcrop and the actual outcrop discovered being 25 feet 7 inches. The rocks throughout these distances of 1,100 and 900 feet are deeply covered with boulder drift, and of uneven surface, so that I may reasonably claim a closer approximation between theory and fact than a mean

*For a description of the structure of the gold districts, see reports on Waverley and Sherbrooke.

*The details of the structure of this district are given in my "Report on the Waverley Gold District." Halifax, N.S., 1869.

†Waverley gold district is thirteen miles from Halifax, on the line of railway from Halifax to Windsor.

difference of in outcrop of 25 feet 8 inches over a horizontal space of 2,000 feet.*

The geological structure of the Waverley gold district being the type of the structure of most of the other known districts, the importance of ascertaining the correctness of the views I had expressed respecting the origin, distribution, and general course of the lodes, and the laws to which they were subjected, acquired some interest, for, if generally true, some mining operations would be much facilitated in a country sometimes deeply covered with drift clays and gravels. Hence I quote, with much satisfaction, the following testimony from the Chief Commissioner of Mines, taken from his official report for the year 1869, p. 9:—

"*Waverley.*—Operations have been carried on in this district by the Lake Major, Rockland, American Hill, and Waverley Gold Mining Companies, and by Leopold Burkner, Esq. The most noticeable feature in this district is the tracing of the southern outcrop of the celebrated Tudor lode, by a series of openings connecting two points eleven hundred feet distant, and thus proving the correctness of the views entertained by Professor Hind, of the geological structure of this district, as described in his report, and fully exemplified in the map accompanying that report. The South Tudor has been now traced for upwards of eleven hundred feet, and the mean difference between the outcrop assigned by Professor Hind and the actual outcrop, disclosed by shafts, does not exceed twenty-five feet six inches throughout that horizontal distance."

Mr. Rutherford, the Provincial Inspector of Mines, also states as follows in his official report for 1869:—"A short distance west of his workings on the Tudor lode, Mr. Burkner has sunk a series of shafts on a lode ranging in a somewhat parallel direction with the South or Nigger lode, formerly worked by him. Five shafts are being sunk on this lode, their present depth being about 50 feet, and the lode is taken out, by underhand stoping, the entire range of the shafts, with the exception of a bulkhead or divisional piece, four feet thick, which is left in the centre of space between each shaft. The lode varies in thickness from twelve to five inches; it dips to the north-west. The trending of the strike of this lode towards the north and east has been followed from the shafts to within a few feet of the old workings on the Tudor lode, and its identification with that lode been established, and the construction assigned by Professor Hind to this part of the Waverley district confirmed."

The so-called barrel quartz, at Waverley, is a fair representation of a corrugated lode occurring on the crown of an anticlinal. In nearly all the gold districts the same form of quartz beds may be seen, and in similar relative positions. The corrugated structure is not confined to the quartz, but spreads fan-like into the overlying rocks, and appears to be in part the result of unequal pressure during the folding of the strata.

The foregoing observations apply to the old contemporaneous beds of auriferous quartz; but there is another class of lodes which have generally a bedded structure, but are of subsequent origin, and may be styled intercalated beds. These will be noticed in subsequent paragraphs.

In every district in Nova Scotia, it is remarked that the gold frequently "runs in streaks," that is to say a zone of rich auriferous quartz occupies a certain breadth as the lode, while to the east and west of that zone the quartz is comparatively poor in the precious metal. It is also found in different districts that the "gold streak" has a different angle with the horizon, and that sometimes the course of the rich zone corresponds, or is coincident with the ripples or swells in the lodes, and also that the gold streak varies in direction in different leads.

The position and dip of the gold streak being found on one side of the anticlinal, it can be traced to corresponding lodes on the other side, with such variations in dip as agree with the section of the curve of the anticlinal.

The term "gold streak," in Nova Scotia, is synonymous with the term "chimneys," in California, and "pipes," in Australia.

IV.—Structure of Sherbrooke Gold District.*

If a slightly undulating line be drawn on a course S. 83° West (true), or N. 75° W. magnetic, from area 775, on the east side of the St. Mary's River, it will represent part of the axis of the Sherbrooke anticlinal. On the north side of the axis, the lodes dip to the north, at an angle generally of about 45 degrees, except when approaching the axis, where they commence to curve. On the south side, the dip varies from 80 degrees to vertical, except when making the curve. Proceeding south from the axis, the lodes become more persistently vertical, until they acquire a slight northerly dip, thus showing that the form of the anticlinal is that of a slight overturn to the south, as represented in the sections. On making the curve, some of the lodes sweep gradually round with a dip, varying from 80 degrees south to 60° S.W., 35° S.W. by W., 26° W., then gradually increasing until they acquire the normal dip on the north side of the anticlinal, of about 45 degrees north. The plan of the Root-hog lode shows this curvature with some degree of detail. The strata and contemporaneous lodes at Sherbrooke, like those at Waverley, may be described as beds of slate and quartzite, with thin sheets of auriferous quartz folded in an overturn anticlinal form, and subsequently tilted to the east by a cross anticlinal. The denuded crest of the intersection of the anticlinals has exposed the sheets of quartz in the form of long semi-ellipses, whose bases rest upon Cambrian gneiss, from which the Silurian quartzites and slates have been removed by denudation. Numerous dislocations, having generally a north and south course, occur at Sherbrooke. These appear, like those at Waverley, † to have taken place during the north and south folding; some of them are represented on the plans and in the sections.

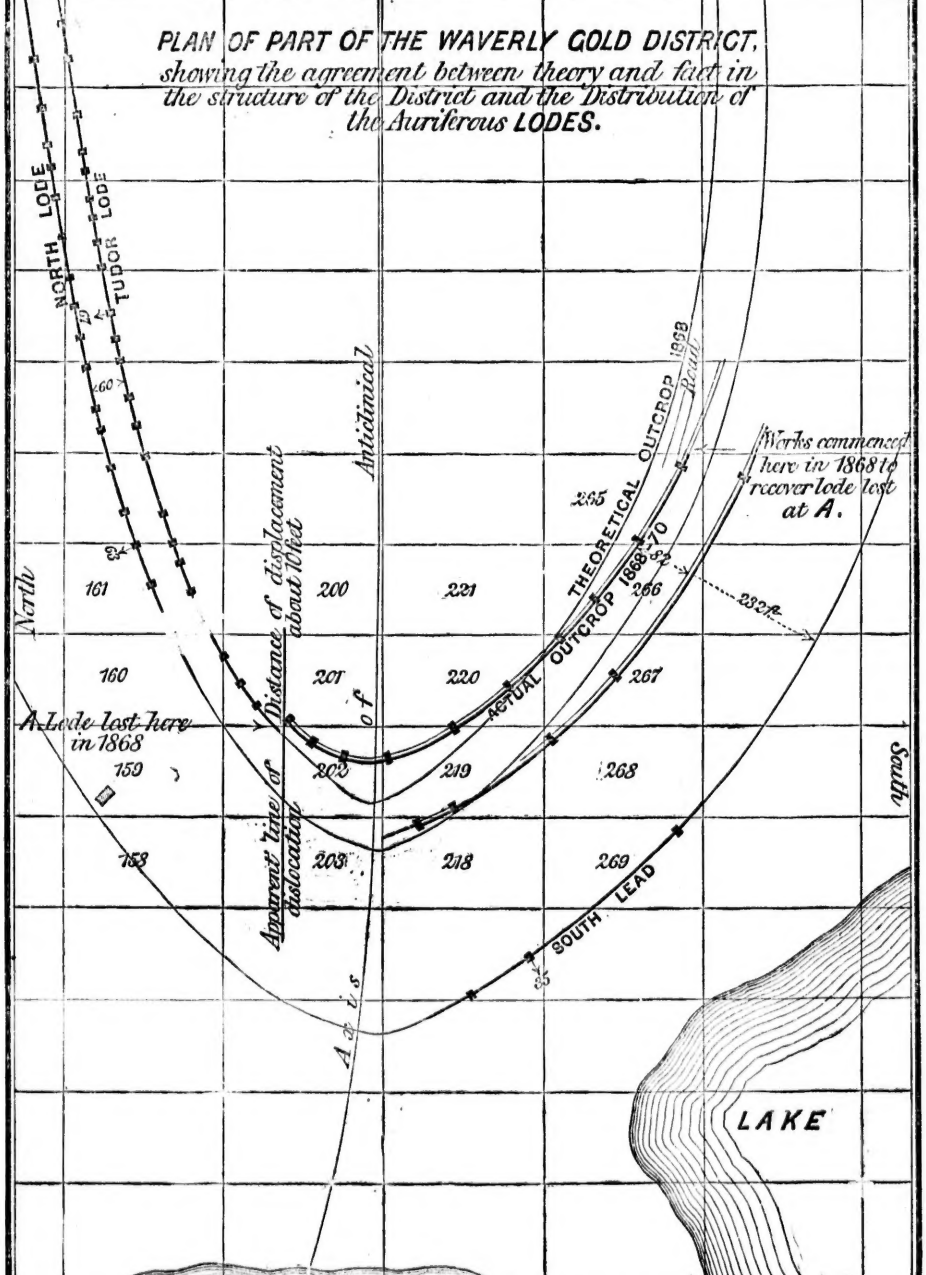
V.—The Auriferous Lodes.

As much misapprehension might arise from the broad statement that all the auriferous lodes in Nova Scotia are sheets of quartz, generally traceable from one side of a tilted anticlinal to the other side, in unbroken continuity, it is necessary to state distinctly that, although the sections exhibit this relation, yet it holds good only with reference to certain lodes which have been so traced, and to groups of lodes. This arises from the structure of the lodes. In many instances they are not continuous for very long distances, that is to say, they "thin out" and "take up again." In some instances the same lodes can be traced at the surface for many hundred yards, and even for miles, but it is safe to assume that generally, as stated in my report on Waverley gold district, they resemble thin lenticular sheets of quartz, whose edges overlap one another, especially in bands of slate. In making cross-cuts at some distance below the surface, lodes are frequently cut which do not appear in the surface trenchers, and in broad bands of slate, lodes thicken to the breadth of 10 to 12 inches, and thin out to a film of quartz, or disappear altogether in the space of a few hundred feet. But before they thin out altogether, another lode begins to appear, separated from the first by a few inches, more or less, of slate or quartzite. This cannot be strictly regarded as a continuation of the lode which has "thinned out," although

* For details, see letters entitled "Theory and Practice at Waverley," appended to a "Preliminary Report on a Gneissoid Series, underlying the Gold-bearing Rocks of Nova Scotia." G. M. Anther, Halifax, 1870.

* The gold district of Sherbrooke is situated about twelve miles from the mouth of St. Mary's River, in the county of Guysborough. It is eighty miles east of Halifax in an air line.

† For a description of the dislocations at Waverley see report on that district.



The thick lines represent the worked portion of the lode; the thin lines indicate the supposed outcrop under a deeper deposit of drift in October, 1868. The double black lines show the continuation of the lodes discovered and worked since publication of the map up to January 7, 1870.

it also may thin out and be in part overlapped by another lode in the strike, and in the place of the first one which had disappeared. Some lodes of this description appear to belong to the class of intercalated lodes, that is to say, they are sheets of quartz which have been formed at a later date than the enclosing rock, and were produced by the replacement, particle by particle, of a of pre-existing bed of some other soluble material. In lodes of this class, which generally occur in slate, the slate itself is found to be auriferous, and the whole mass is frequently worth crushing.

The strong persistent contemporaneous lodes, such as the Tudor and North lodes at Waverley, generally occur in quartzite, or with quartzite on one side and slate on the other. The intercalated lodes now frequently occur in slate, and are often associated with thin lenticular beds of slate and quartzite, which also "thin out" and "take up" again.*

We have, then, in Nova Scotia, the following description of lodes, all of which are more or less worked :—

1. The bedded lodes of the same age as the quartzites, and slates with which they are interstatified.
2. The intercalated lodes of subsequent age.
3. The gash lodes (free claim, Renfrew).
4. The true veins. A few worked. Most of the gold is obtained from the bedded and the intercalated lodes.

The origin of the intercalated lodes is obscure, but the conditions required for the formation of some of these appear to be in great part satisfied, if we suppose that they represent lines of minimum pressure during the folding, denudation, and faulting of the strata. Along such lines the flow of aqueous currents would be determined, and particle by particle of soluble strata be removed and replaced by other minerals. This would also account for the regular arrangement of crystals of arsenical iron pyrites in slates and quartzites, in certain lines of direction, over wide areas. According to this view, the formation of intercalated lodes is continually going on, for the pressure upon any given point, at any given depth, is constantly changing, owing to denudation and other causes constantly operating, although in no form perceptible to the senses.†

The passage of a bed of quartz from one plane to another plane, on a short zig-zag course (seen at Mount Uniacke), may be referable to this class of intercalated lodes. The same reasoning which is applicable to explain the formation of intercalated lodes, may render it doubtful whether any bedded lode can strictly be regarded as a lode altogether of contemporaneous age with the enclosing rock. The statement that it is so may apply to certain portions of such a lode, and to the *locus* of the lode, but it is difficult to conceive that during the infinity of changes of pressure which must have occurred in any given subterraneous area, aqueous currents may not have been successively determined towards every part, and caused a greater or less replacement of particles. Under the term aqueous currents, it is scarcely necessary to say that I allude more particularly to the water absorbed by different strata under different conditions of temperature and pressure.

VI.—Mining Economies in Nova Scotia.

I propose now to glance briefly at the condition of mining in Nova Scotia, and then to furnish some facts from official returns, which will enable a correct appreciation of the gold wealth of the Nova Scotian lodes to be formed.

From the most reliable information accessible, it appears that there are now some seventy companies or associations engaged, actually or nominally, in gold-mining in Nova Scotia:—

No. of Companies.	Where organised.	Estimated cost and actual working capital.
16	Montreal	480,000 dols.
6	Toronto.....	240,000 „
7	Kingston	210,000 „
2	New York	250,000 „
10	Boston	500,000 „
2	St. John, N.B.	50,000 „
12	Halifax, N.S.	134,000 „
3	United States	60,000 „
3	Ontario.....	60,000 „
3	Nova Scotia.....	10,000 „
1	Liverpool, Eng.	25,000 „
2	London „	85,000 „
6	Private	20,000 „

Some of these are of a purely speculative character, some have ceased working, others are profitably carrying on the business, but, as shown in succeeding paragraphs, in a very unscientific and wasteful manner. A few are working with comparative economy, but no approach is made to the admirable system which frequently obtains in Victoria, where that best of mining schools, experience, has taught miners to conduct gold mining with the same attention to detail as is thought absolutely essential to success in any other branch of industry.

In very many cases, mismanagement has been the cause of the suspension of works, which, with ordinary care in the hands of an experienced agent, would have proved successful.

Local companies have been often formed in the following manner:—A prospector finds a lode showing numerous specks of gold at the surface. Three or four speculators join together and form a company, purchasing the property for a nominal sum, and a considerable portion of so-called paid-up stock. They put the capital at 100,000 dollars (100,000 shares at one dollar a share). The shares are sold at two cents and upwards. With the money thus obtained, work is commenced, and if the quartz continues promising, enough capital is raised to erect a mill, and there is a prospect that the speculation may turn out profitably; but if the auriferous character of the quartz diminishes, the collapse of the company becomes a mere question of time, for the shareholders almost invariably refuse to submit to a call.

The following tables show the average yield of gold from quartz in Nova Scotia and in Victoria (Australia):—

Average Yield of Gold in Victoria from the year 1859 *to* 1868 *inclusive.**

Year.	Quantity crushed.		Total produce.		Average yield per ton.		
	tons.	cwts.	oz.	dwts.	oz.	dwts.	grs.
1859	39,034	0	47,524	14	1	4	8·4
1860	86,594	16	81,905	2	0	18	22
1861	350,409	0	299,482	13	0	17	2
1862	567,208	0	310,725	4	0	10	22
1863	523,226	0	323,190	14	0	12	8·5
1864	843,515	10	433,981	16	0	10	6·9
1865	705,134	0	419,325	3	0	11	21·4
1866	861,468	13	459,895	7	0	10	16·2
1867	948,850	12	498,677	12	0	10	12·2
1868	886,228	18	471,493	3	0	10	15·37
Totals ..	5,811,669	9	3,346,201	8	0	11	12·37

* "The Gold Fields of Australia." By R. Brough Smyth, F.G.S.

* The intercalated lodes are to be distinguished from segregated lodes occupying fissures produced by a crush in the strata, as on the free claim at Renfrew gold district. (See report on Waverley.)

† For a discussion of this subject see "Report on the Gold District of Sherbrooke," now in the press.

Statement showing the number of tons of Quartz crushed, the yield of Gold, and the average yield per ton, in the Province of Nova Scotia, during the years 1862 *to* 1869 *inclusive.*

Year.	Quartz crushed.	Yield of gold.			Yield per ton.		
	tons.	oz.	dwts.	grs.	oz.	dwts.	grs.
1862	6,727	6,799	0	0	1	0	5
1863	17,001	13,973	14	17	0	16	12
1864*	15,316	14,526	18	5	0	19	0
1865	23,835	24,725	22	22	1	0	21
1866	30,963	24,125	13	18	0	15	14
1867	30,673	27,534	4	14	0	17	23
1868	31,242	20,518	10	14	0	13	3
1869	35,424	17,690	2	8	0	10	2
Totals ..	191,181	149,894	7	2	0	15	16

In Victoria, the yield of gold from 5,811,669 $\frac{8}{20}$ tons of quartz crushed during a period of ten years (1859 to 1868) has averaged 11 dwts. 12·37 grains.† In Nova Scotia, the yield from 191,181 tons of quartz has averaged 15 dwts. 16 grs. The excess of the average in Nova Scotia over that of Victoria amounts to more than 4 dwts. per ton. Notwithstanding this large average in favour of Nova Scotian quartz, yet the mining interests are depressed, while those of Victoria are buoyant. The cause of this apparent anomaly is readily explained. In Nova Scotia, we are passing through that stage of blundering incompetency which has already visited Australia and California, and from which those countries have emerged with wonderful strength and aptitude for the circumstances in which they are placed.

The economy displayed in the management of the mine, and in the manipulation of the quartz now common in Australia and California, is utterly unknown in Nova Scotia. It will appear almost incredible that the tailings alone in many mining districts contain, on an average, as much gold as the material crushed, with a profit at some of the mines at Ballarat. Numerous and reliable assays show that, in Nova Scotia, from 25 to 35 per cent. of the gold escapes in the tailings, and is lost.

The arsenical pyrites, which abound in some districts, is frequently rich in gold, but no attempts are made to separate it, or even store the pyrites.

The following table shows the result of assays of pure arsenical pyrites from different lodes at Sherbrooke‡:—

	Yielding gold per ton.	Yielding silver per ton.
	oz. dwt. gr.	oz. dwt. gr.
Pyrites and galena from Boulder Lot	4 1 16	8 19 10
" " " Coburg Co.	1 12 16	6 10 16
" Kingston and Sherbrooke Company	4 18 0	5 14 8
" Canada Company	45 0 0	0 0 0
" Wentworth Company (Ferguson Lode)	0 16 8	0 0 0
" Meridian Company (Sears Lode)	1 12 16	9 0 0
" average of concentrated tailings	2 10 0	0 0 0
Assay of pure pyrites from the Provincial Company, at Wine Harbour	11 8 16	0 0 0

From careful assays of numerous parcels of tailings in Nova Scotia, as they came from the mill, and selected indiscriminately, the average quantity of gold contained was found to exceed 4 dwts. per ton. In many instances the assay gave a very much larger yield. These tailings lie around the mills in every direction, or are allowed to run into the nearest stream; in no instance known to me are they concentrated, even to save the pyrites, or are any really valuable appliances used to save the free gold they contain, which has escaped from the stamping boxes on the amalgamating tables.

At one mine, near Ballarat, 7,453 tons of quartz yielded no more than 2 dwt. 10½ grains per ton, yet the company paid in dividends £2,101 10s. The quartz was easily obtained, and at small cost, but the manipulation was very economically conducted.

At the Black Hill mine, Ballarat, the total quantity of quartz crushed, up to 1868, was 190,118 tons, yielding 22,801 oz. 15 dwts. 13 grains, the average yield being 2 dwts. 9·7 grains per ton.*

A year ago, attention having been called to the escaped gold in the tailings at one of the mills at Waverley, portions were re-crushed and passed over the amalgamating tables; and in the official returns for 1869 we find the following statements:—288 tons of waste from dump gave 32 oz. 5 dwts. 11 grains; 63 tons of waste from dump gave 13 oz. 12 dwt. 16 grains. From this experiment some idea may be formed of the amount of gold allowed to escape in the tailings from upwards of 190,000 tons of quartz, the quantity already crushed in Nova Scotia.†

VII.—Mining Economies at Waverley.

The mine which I shall select, as an illustration of gold-mining at Waverley, is the one where part of Tudor lode is worked. The following extracts from my official report in 1868, compared with what is now being done in 1870, will afford a fair example of the improvement of which Nova Scotia mining is susceptible:—The mill at this mine is driven by water; it has sixteen stamps; amalgamation takes place in the battery and on tables; no blankets are used, or concentrating apparatus of any kind to save the pyrites of free gold which have escaped amalgamation; the tailings flow into the stream and are lost. In the year 1865, 6,972 tons of quartz were crushed and treated in the manner described. The yield of gold amounted to 8,727 ounces, or 1 oz. 6 dwts. 12 grains per ton. The total cost of getting the gold, up to the close of 1866, averaged 12 dwts. (12 dollars) a ton. In 1867, the works were carried on with greater economy, and the lode, at a depth of 300 feet, averaged 15 inches in thickness, and yielded (not including the tailings) 8 dwts. a ton, and was worked with a small profit. When the average yield fell to 7 dwts. a ton, the works were stopped, on account of not paying expenses. This was the condition of the mine during my visit in the autumn of 1868.

The following are abstracts from my report on this district:—

"The skill which makes a difference of one pennyweight per ton frequently determines the fate of a valuable mining property. In the case of the fine water-power mill at Waverley, seven pennyweights to the ton is stated not to pay expenses; eight pennyweights would leave a small profit; and nine pennyweights, it is said, would secure a profit of forty dollars a day. Operations are now suspended, because the quartz is said to yield only 7 dwts. per ton, according to the present system of working. Subsequently, it will be shown that there is every probability that the quartz now contains upwards of 10 dwts. to the ton, although it yields only 7 dwts., and that by system and machinery, and consequent reduction of expenses, it might be made

* Nine months.
† "The Gold Fields of Victoria." By R. Brough Smyth, F.G.S.
‡ Mr. Kirkpatrick.

* Mr. Brough Smyth.
† See also tables showing returns from Sherbrooke district for remarks on gold in the tailings.

to give an equivalent to 10 dwts. to the ton. The same observation applies in other forms to all the other properties in the district.

"At a depth of 330 feet on the Tudor lode, the yield was 7 dwts. per ton, and the mineral not paying expenses, the work was stopped. It has been shown that it is probable that one-third of the gold was lost in the tailings, which were allowed to escape from the copper plates in front of the battery directly into the river. This would give a total average of gold in the quartz of 10 dwts. 12 gr., of which 7 dwts. was saved, and 3 dwts. 12 grs. lost. Assuming that 76 per cent. of the gold in the tailings could be recovered by the usual processes, at a cost of one-fourth, this would leave a profit on the tailings of 1 dwt. 16½ grs., and swell the total yield to 9 dwts. 15 grains per ton. A round buddle, with a bed 18 feet in diameter, and whose axis revolves at the rate of 3 or 4 revolutions per minute, will work up from 35 to 40 tons of tailings in 24 hours. A rotating buddle will do the same amount of work in much less time, and may consequently be made of smaller diameter. By the substitution of proper machinery, much manual labour in milling could be saved. Ten men were employed during 24 hours in breaking and feeding 35 tons of quartz; why should not this work be done by 4 men feeding a 'breaker' with hopper, and moved by the surplus water-power? Each of the stone-breaking machines at the Port Philip Company's mines break 8 tons of quartz per hour, at a cost, including wear and tear, of about 10d. per ton. One of these machines would break 35 tons of quartz in 4½ hours, at a cost of about 5 dols. by water-power, the estimate 10d. (stg.) a ton being based on steam power. Hence, with a 'breaker' and 'hopper,' instead of manual labour, a saving of at least 3 dols. a day might be effected, and the risk of gold being stolen during this part of the treatment reduced to a minimum, by which it is not improbable a still greater saving might be effected.

"I have selected as an illustration of mining economics at Waverley the method of treating the quartz at the cheapest mill, namely, one driven by ample water-power. All the other mills in operation are driven by steam-power, amalgamation takes place in the battery and on tables; but no effort is made to concentrate the tailings. As long as quartz continues to yield the unusual average of 1 oz. to 1 oz. and 10 dwt. to the ton, the economical treatment of the tailings is not a matter of vital importance, but when the average diminishes to 9, 8, and even 7 dwts. per ton, it becomes one on which, other things being equal, the continuance of active operations depends, provided that those operations are necessarily limited to one or two leads."*

Let these statements of facts in 1868 be contrasted with the following in March, 1870. My authority is one of the mine-owners at Waverley, to whom I applied for information respecting the progress of his works, in February of the present year. The mill and mine are the same as referred to in the preceding paragraphs:—

"I work at present four shafts on the south side, on tribute, which leaves my men with a yield of 3 dwts. per ton on average, from 1 dol. to 1 dol. 50 c. clear wages for every working day, and to me something over 50 cents per ton. The difference between 1 dol. and 1 dol. 50 c. wages depends entirely upon the greater or smaller ability and industry of the miners, by which they will raise larger or smaller quantities of quartz per day, which, with such a small yield as 3 dwts. per ton is all important.

"My arrangement with the miners is, that they get for their labour and the expenses, except crushing and hauling, all the gold, and pay me for crushing and hauling 1 dol. 25 c. per ton.

"The lode is from twelve to eighteen inches thick, and three men raise, on an average, from fifty to sixty odd tons of quartz per month. That the lode works extraordinarily easy is a matter of course; deducting the crushing and hauling, there remains not much more for the raising of the quartz than a little over 1 dol. 50 c. per ton.

"In proof of my own profit of at least 50 cents per ton, you will find the following calculations:—I crush with eight stampers, in twenty-four hours, at least 13 tons on the average, and for this work I employ two very experienced feeders, who have, at the same time, charge of the mill, and two breakers. Of the feeders, one receives 1 dol. 40 c., and the other, 1 dol. 35 c. a day; and of the breakers, one 1 dol. 25 c., and the other, a boy, 1 dollar per day, that is altogether 5 dollars. This makes, with 13 tons, 38 dols. 5 c. per ton. The whole expenses of wear and tear (in the main part stampers' shoes) and loss of quicksilver, are under no circumstances higher than 15c. per ton, which would bring the crushing expenses up to 53 dols. 5 c. per ton. The hauling costs 20c. per ton, and this shows that I make at least 50c. per ton clear.

"I think this is the first instance that a lode of this thickness has ever been worked with a profit, at a yield of 3 dwts.

"Quite different is it with the South Tudor lode, which works very hard, a great deal harder than ever the north dip worked. The two reasons of this are, first, that the south dip is so very much flatter than the north dip, and, second, that the small band of soft slate (goudge) which was nearly everywhere (with some interruptions) on the north dip, is nearly entirely wanting on the south dip, which makes the stripping of the lode a by far more difficult task. Nevertheless, I work the lode as cheap as I ever worked the north dip in the cheapest time; but the men had to work harder to make a living by it than they ever worked before. If it was not for the great scarcity of work, they scarcely would endure it long, particularly in this humid winter, where half their time is lost by water-pailing (hoisting water in buckets).

"I pay 10 dollars for sinking and 40 cents for stopping, the men to find everything, which brings up the cost, crushing and hauling included, to about 9 dollars per ton. I am putting up now a gin, and commence to sink down one shaft in advance of the others, preparatory to dispensing with all sinking except in the one shaft, which will always be the deepest point, and from which the lode is stopped out east and west, in the form of terraces. I have no doubt that this arrangement will bring down the expenses to 8 dollars per ton, everything included. How long I shall be able to work without a pump I cannot say, but Lake Major Company has worked without it down to 300 feet, though I have at present by far more water than there was in this part of the north dip.

"My experience on the north dip has convinced me that, as long as the formation remains the same, the mining expenses do not increase, down to at least 300 feet, and I am sure a good deal further, except in expenses of the pump. Where there is a pump, a horse gin will raise from two shafts all the quartz that can be mined, just as well from 300 feet depth as from 100 feet. I do not save the pyrites yet, because I have not yet put up a German buddle."

The system of mining generally adopted in Nova Scotia greatly increases the expenses of raising the quartz.

On the plan, page 615, the positions are marked of the shafts on part of the Tudor and north lodes.

The north lead and the Tudor lode are, on an average, 60 feet apart at their outcrops, their dips being nearly the same. The number of shafts sunk by different companies on these leads, within a mean distance of 2,000 feet, is 54, having a mean depth of 200 feet. This is equivalent to a shaft to every superficial area of 47 feet square.

* Report on the Waverley gold district, 1869.

On area 155,* for example, there are four shafts on the Tudor lode, and three shafts on the north lead, the breadth of the area being 150 feet. On area 102, there are three shafts on the Tudor, and three on the north lode, the same on areas 164 and 102. On the property of one company there are eight shafts on the north lead, in the space of 450 feet, and nine shafts on the Tudor lode within the same distance. The lodes being but 60 feet apart, two main shafts, with suitable hoisting and pumping machinery, and cross galleries, would have been ample, and the saving in labour and time would have greatly reduced the cost of mining the quartz.

A remarkable instance of want of foresight, in a most important department of mining economics, is presented in the construction of one of the largest steam crushing mills at Waverley, and this is but a fair illustration of inattention to important details, which are common in the Nova Scotian mining districts. The site selected for this mill is so low that the tailings, as they leave the mill, are now required to be hoisted by a revolving wheel, furnished with buckets, to a sluice, where they have an opportunity of escaping over the accumulated heaps near the mill, but without any attempt at concentration, or saving any of the gold which they undoubtedly contain. This is equivalent to employing power, machinery and labour, to get rid of 1 dwt. 16½ grains of gold per ton. A buddle, to concentrate the tailings and save the gold, could have been constructed at far less cost than the present ingenious contrivance to hoist the tailings out of the way.

The reasons why failure and collapse, in place of continued prosperity, has characterised some mining properties in Waverley, and indeed throughout Nova Scotia, I have already officially stated to be as follows† :—

1. The absorption of all returns to pay large dividends.
2. The small size of some of the properties.
3. Insufficient working capital at the outset.
4. A uniform neglect in preserving records and plans in detail of the works.
5. Inadequate machinery and appliances to save gold.
6. The want of labour-saving machinery.
7. Ignorance respecting mining operations, the "gold-streak," or "chimneys," or "pipes," or zone of auriferous quartz.
8. General neglect of the contract and tribute system.
9. And, as a necessary result of the foregoing, the frequent incompetency of some of the so-called managers.

VIII.—Mining Statistics.

The following tables have been kindly supplied by the Commissioners of Mines at Halifax, and they have all the seal of the office attached to them. A glance at these tables will show that the gold yield from quartz of some of the Nova Scotian districts is in excess of the average of gold-mining countries generally. Tables are also given of the yield of certain mines in each district, from which some ideas may be formed of the productiveness of the quartz, and of the extent to which the returns might be increased if the same economy in mining, skill in manipulation, and eagerness to adopt improvements existed in Nova Scotia which are now common in Australia and California. The decrease in the general annual average at Sherbrooke is due to the cessation of the process of culling the quartz, which was to a large extent common in the infancy of mining in Nova Scotia. At the present time, not only in the quartz of the lode crushed, but also some inches of the adjoining slate, and at Musquodoboit, and Isaacs Harbour, broad bands, from 14 to 20 feet of mixed slate and quartz, are crushed with returns shown in tables.

* A mining area in Nova Scotia is 150 feet on the lode, by 250 at right angles to it. The original course of area lines is established by the Government District Surveyor

Vide report on the Waverley Gold District.

Sherbrooke Gold District.

Statement of Quartz crushed, and Gold obtained from the Sherbrooke Gold District, during the years 1863 *to* 1869 *inclusive, together with the average and maximum yield of Gold per ton, as shown by the Quarterly Returns rendered the Department of Mines.*

Year.	Quartz raised.	Gold obtained.			Average yield.			Maximum yield.		
1863	3,454	3,304	14	12	..			12	0	0
1864*	1,909	2,611	6	22	..			20	0	0
1865	2,637	3,137	9	5	..			8	3	0
1866	2,684	5,157	14	17	1	22	0	16	6	16
1867	5,809	8,522	8	11	1	9	8	11	13	5
3 mos. do.	2,376	2,708	8	18	1	2	19	5	0	0
1868	8,880	7,070	0	5	0	16	0	12	15	0
1869	11,590	5,546	11	16	0	9	15	6	9	13
Total..	39,249	38,058	14	10	0	19	9	20	0	0

* Nine months to September 30.

In 1862 there was obtained 2,023 ounces (as near as could be ascertained).

Statement of labour performed on areas 650, 651, 652, 680, 681, 682, *block* 3, *Sherbrooke District, the property of the Wellington Gold Mining Company, during the years* 1863 *to* 1869 *inclusive, and results.*

Days.	Date.	Quartz crushed.		Yield of Gold.		
		tons.	cwts.	oz.	dwts.	grs.
1,800	1863. Dec. 31..	149	16	222	15	2
500	1864. Mar. 31..	32	15	95	10	22
300	June 30..	40	4	71	5	5
780	Sept. 30..	16	1	39	12	2
666	Dec. 31..	13	0	27	10	12
459	1865. Mar. 31..	18	19	13	11	16
710	June 30..	109	0	107	17	19
737	Sept. 30..	107	0	428	15	0
1,297	Dec. 31..	285	18	766	15	2
1,400	1866. Mar. 31..	219	10	298	0	12
1,244	June 30..	409	14	991	6	3
700	Sept. 30..	389	0	871	18	22
1,650	Dec. 31..	266	18	864	4	15
3,000	1867. Mar. 31..	400	0	940	0	0
3,004	June 30..	465	0	634	6	0
2,800	Sept. 30..	335	10	314	14	0
2,000	Dec. 31..	312	10	507	0	0
3,600	1868. Mar. 31..	596	10	1,061	18	6
4,600	June 30..	550	16	456	11	16
3,510	Sept. 30..	844	12	644	5	0
3,500	Dec. 31..	448	12	515	11	10
4,000	1869. Mar. 31..	682	0	600	0	12
4,000	June 30..	1,059	0	794	3	5
3,244	Sept. 30..	731	10	281	2	18
3,800	Dec. 31..	500	17	666	17	0
53,301	..	8,984	12	12,215	13	7

Renfrew District.

Table showing the date, tons of Quartz crushed, and Gold obtained from the Ophir Mine, in Renfrew District, County of Hants.

Date.	tons	cwt.	oz.	dwts.	grs.
1866. Sept. 30.....	677	0	1,000	10	0
Dec. 31.....	1,208	0	2,142	4	0
1867. March 31.....	1,395	0	1,885	15	0
June 30.....	1,503	0	1,674	0	0
Sept. 30.....	1,656	0	1,587	5	0
Dec. 31.....	946	15	907	0	0
1868. March 31.....	704	0	571	10	0
June 30.....	1,317	0	736	3	0
Sept. 30.....	1,385	0	706	15	0
Dec. 31.....	2,029	0	1,046	10	0
1869. March 31.....	1,562	0	724	18	0
June 30.....	1,285	0	612	10	0
Sept. 30.....	850	0	302	0	0
Dec. 31.....	1,915	0	571	10	10
Total	18,432	15	14,468	10	10

Waverley District.

Table showing the quantity of Quartz crushed, and amount of Gold obtained from the German Mines on the Tudor and North Lodes, Waverley District, County of Halifax.

Date.	Days' labour.	tons.	cwt.	ozs.	dwts.	grs.
1863. Dec. 31..	3,370	381	15	151	7	9
„ „ ..	338	47	9	33	18	12
1864. Mar. 31..	1,360	212	10	125	16	14
„ „ ..	3,083	263	0	134	5	14
June 30..	1,700	162	15	132	8	3
„ „ ..	4,800	331	0	224	12	17
„ „ ..	2,550	40	0	30	0	0
Sept. 30..	5,100	759	0	704	11	3
„ „ ..	2,300	294	0	317	12	0
„ „ ..	4,700	306	0	216	15	3
Dec. 31..	5,000	757	0	608	5	5
„ „ ..	2,000	263	0	316	5	16
„ „ ..	4,900	278	0	228	15	12
1865. Mar. 31..	2,500	274	0	375	15	10
„ „ ..	1,800	218	0	491	3	0
„ „ ..	5,000	795	0	811	0	10
June 30..	1,400	305	0	829	11	0
„ „ ..	4,100	1,049	0	1,253	2	2
„ „ ..	2,000	357	0	680	18	1
Sept. 30..	1,700	443	0	772	19	7
„ „ ..	2,300	396	0	517	4	0
„ „ ..	4,000	1,352	0	1,226	12	21
Dec. 31..	1,100	355	0	432	18	0
„ „ ..	1,300	250	0	225	3	0
„ „ ..	3,000	1,611	0	1,253	2	12
1866. Mar. 31..	1,400	350	0	188	3	0
„ „ ..	500	70	0	23	6	0
„ „ ..	3,000	1,210	0	609	1	0
June 30..	6,080	1,500	0	995	0	0
„ „ ..	2,000	245	0	141	18	0
Sept. 30..	2,300	293	0	235	9	15
„ „ ..	5,415	1,406	0	923	0	0
Dec. 31..	1,800	248	0	172	15	0
„ „ ..	3,000	833	0	316	0	0
Total	96,896	17,655	9	15,698	15	18

Stormont District (Isaacs Harbour).

Table showing the quantity of Quartz crushed, and amount of Gold obtained from areas 12 and 13, and other mines on the Mulgreen lode, Stormont district, Guysborough County.

Date.	Days	tons.	oz.	dwts.	grs.	Remarks.
1863. Jan. 30	468	20	120	0	0	
Sept. 30	780	55	119	0	0	Area No. 12.*
Dec. 31	750	57	126	0	0	150ft. on lode.
1864. Mar. 30	700	..	..			250 ft. across.
Jan. 30	1,026	160	368	0	22	
Sept. 30	650	..	..			
Dec. 31	720	90	210	6	4	
1865. Mar. 31	900	42	95	18	0	
Jan. 30	80	13	17	3	16	
Total	6,074	437	1,056	8	18	
1863. June 30	416	22	145	0	0	
Sept. 30	208	48	228	0	0	Area No. 13.*
1864. Mar. 31	600	..	..			
June 30	650	64	260	12	16	
Sept. 30	350	42	97	7	18	
Dec. 31	127	..	..			
1865. April 1	52	8	1	13	6	
Total	2,403	184	722	13	16	

Other mines on shoot (see Report for 1868).

Date.	Days.	tons.	oz.	dwts.	grs.
1864	..	59	183	3	11
1865	..	535	924	8	12

* These areas were mined in 1862, but there was no regular system of return until May, 1863.

Musquodoboit.

Table showing the quantity of Quartz crushed, and amount of Gold obtained at the Bushing Mine, at the Musquodoboit "Jenney" district, in the county of Halifax.

Date.				Remarks.
1869.	tons.	ozs. dwts.	grs.	
April.....	56	37 10	0	Area 19, 20, 21, 22, and 23. Large lode, about 20 ft. in thickness, composed of quartz and slate; about half quartz.
May.....	116	46 8	0	
June.....	158	53 10	0	
July.....	10	19 0	0	
„	155	46 2	0	
August.....	190	51 0	0	
„	5	9 0	0	
September ..	102	32 2	0	
October	94	26 9	0	
November ..	124	35 2	0	
December ..	7	12 15	0	
Total	1,017	368 18	0	
April	10	8 10	0	Hyde lode; area 221 and 231; about 5 in. thickness.
June.....	34	28 5	0	
July.....	14	7 17	0	
September ..	7	1 18	0	
November ..	7	1 15	0	
Total	72	48 5	0	
August	22	71 0	0	Drunbrack lode; 15 in.; area 327.
September ..	23	31 17	0	
October	52	28 10	0	
Total	97	131 7	0	

HYDE'S MINE ON AREAS 221, 222, 223, 224.

1869.	tons.	oz.	dwts.	grs.
October	92	142	11	0
November ..	137	126	0	13
December ..	79	60	19	8
1870.				
January	90	93	1	0
Total	398	422	11	21

DISCUSSION.

The Chairman, in inviting discussion, said he desired to point out that the paper divided the subject of gold-mining into two important points, one being the question as to the occurrence of the gold, for it must be known first whether there was a sufficient quantity of gold in the district to make it worth while for companies to subscribe capital, and expend money in a series of operations carried on for many years; and the second question referred to the method of, and economy in, extracting the gold. On the former question he should have some to say himself; and with regard to the latter, Professor Hind had gone pretty fully into it, pointing out nine distinct causes of failure which had come under his own notice. If any gentleman present had had any experience in works of this kind it would be desirable that they should give additional information or confirmation of Mr. Hind's statements, particularly with regard to the stratification of auriferous quartz in Nova Scotia.

Mr. Robinson said he might venture to make one or two remarks on the method of mining adopted in Nova Scotia, having recently visited that country, and being acquainted with the progress of operations there. With reference to the theoretical part of the question, he might refer those interested in it to a paper which was read before the Geological Society, a short time previously, by Professor Hind, giving a very elaborate account of the structure of the province. Having visited Waverley with that gentleman, he could confirm generally what was stated with respect to the imperfect arrangements made for mining; in fact, it was not so much mining as tinkering or surface work, as was shown by the fact that for a lode 1,500 feet in length 54 shafts were sunk to extract quartz. As to the arrangements of the strata also, he quite agreed with what had been stated, and in one district with which he had most to do, Lawrence-town, the strata was proved to be a synclinal fold. In fact, after working there for six months, the result showed that the form of the lode was as nearly as possible exactly what was predicted in the first investigation of the district. With regard to Waverley, the lode there was lost by reason of a fault, and when he visited the place with Professor Hind, in 1866, its position was of great importance, inasmuch as the whole settlement was at a standstill for want of employment. Subsequently to his investigation it was again discovered, and operations were doubtless now in full swing again. One of the districts, not specially alluded to in the paper, Montague, was very remarkable for the very large yield which had been found from the commencement, the returns of the Chief Gold Commissioner showing that, for a series of years, there had been a yield of 1 oz. 5 dwts. per ton, which was the highest on record. The tailings there had also been assayed, when it appeared that 13 dwts. per ton were being thrown away. Those acquainted with gold mining knew that in a well managed mine, with good mill-power and proper machinery, the cost of getting did not exceed 4 dwts. to 5 dwts., so that when they found that 13 dwts. were absolutely wasted, in addition to the 1½ oz. obtained, it was abundantly evident that the importance of Nova Scotia, as a gold-field, could hardly be over-estimated. Oldham was another part which he visited, and there he found the yield of gold exceeded 1 oz. per ton at some small workings, which were now being considerably extended with the aid of English capital. In conclusion, he thought Professor Hind was entitled to the thanks of the public for bringing this matter forward, for it was now evident that, with such a supply of gold in the nearest of England's dependencies, there was an enormous source of wealth only awaiting the operation of English enterprise and capital. He held a decided opinion, which he had often expressed both in public and private, that Nova Scotia would be found to be one of the most important gold fields in the world when its resources were properly developed.

Mr. Arthur Sopwith said he had just returned from Nova Scotia, and he could to the utmost corroborate the statements made by Professor Hind, as to the manner in which mining was conducted there. One of the most important points in any large gold-producing country was the treatment of the tailings and arsenical pyrites, from which the gold was more difficult to separate than from any other metals with which it was found combined. It was not exactly within the scope of the paper, which treated principally of the other district, but he might mention that in the Montague mine, which was one of the most interesting in the province, and was in the neighbourhood of Waverley, there were found in the foot sole of the lode masses of arsenical pyrites about the size of two fists joined together, at very short intervals, and this really amounted to a considerable portion of the lode, which was only two inches thick; but the persons working that mine were so ignorant of anything like the assaying of ores, that they were actually storing it, and proposing to send it over to Swansea, paying heavy freight to have it smelted there. It was very probable that this pyrites would give from £80 to £120 per ton, at any rate if the statements made were anything like correct, as it was in appearance exceedingly rich. With regard to the cost of mining, the Nova Scotian methods of working were very limited; but, on the other hand, it must be remembered that unless sufficient capital were subscribed to carry on operations, for a long time it would not pay to erect good machinery and pumping gear, which would have to be abandoned in case of meeting with barren ground. It was the case in all metalliferous mines, that a large proportion of barren ground had to be opened, and unless there were plenty of capital, a person might be ruined at once by setting up expensive machinery. The fact was not a single mine in Nova Scotia had been started with anything like what would be considered in England a sufficient capital. That the lodes were in some parts exceedingly auriferous might be gathered from this fact:—he had himself been down nearly 200 feet, working a lode of only four inches, which was worked a length of about 300 or 400 feet, which had necessarily required the taking away of a large part of the adjoining rock, but, nevertheless, the work had been successful. Not only were there these position beds, for there could be no doubt they were true beds, but also a great number of cross leads, and at some points the intersections of these cross leads was the richest part of the lode. This was a point which required a good deal of attention, because if the cross lead were struck, it might cut through two or three lodes without being cut out, and at all points of intersection it might be very rich. By striking on a length of cross lead, and through the main leads, which, as a rule, lay pretty close together, the work would be found much more productive than trying here and there in a main lode, trusting to chance to get a nest of gold.

Dr. Boycott said it appeared, after all, that what was wanted for working these mines was, not so much money as more information and skill. It seemed a great pity that these operations should be undertaken by such ignorant people, for it appeared pretty plain that many of the miners lacked the commonest information, which was now distributed pretty well all over the world, through the influence of the School of Mines in Jermyn-

street. He was, therefore, astonished to find that there was so much waste of money and labour still going on, and that some means were not adopted for securing information. The mere statement of such facts sufficed to show the necessity for education being extended in a greater measure to our colonies, and, if possible, he thought government should send out inspectors to see that these mines were properly worked. He should like to know whether the Chairman's opinion coincided with that of Professor Hind as to the gold being deposited from sea water.

Mr. Botly said society at large must be indebted to Mr. Hind for the paper he had prepared, and particularly for calling attention to the nine causes which had produced failure and collapse in so many cases. Several of them, such as the absorption of the whole of the returns to pay large dividends, the smallness of the operations, the want of labour-saving machinery, and the incompetency of so-called managers, had been fruitful sources of loss in England, particularly the last, and therefore he could well believe that no successful gold mining operations could be carried on while they continued to exist.

Mr. Robinson, in reference to what had fallen from Dr. Boycott, said that mining in Nova Scotia was of very recent date, and, of course, as in the case of all other countries, they had to go through a sort of apprenticeship before much progress was made. There was an inspector of mines in Nova Scotia, who was well qualified to give every information, but he did not apprehend it came within his department to tell persons when they were spending their money foolishly.

The Chairman said that, as an old dabbler in gold mines in various parts, he could not help feeling much interested in the paper, following up as it did the accounts which had been received from other sources, with regard to a colony so near to the seaboard, and which appeared to offer so many inducements to the capitalists to embark in mining enterprise. There was nothing so pleasant as gold mining, if you could only get a sufficient yield, for there was no trouble whatever in disposing of the product, as was sometimes the case with large quantities of bulky produce. But on the other hand there were certain disadvantages, amongst the principal of which were the great uncertainty and the great proneness to accident amongst the veins which produced the gold. On this part of the subject he could not help saying that, although Mr. Hind had appeared to make good his statement as to the structure of this part of Nova Scotia, he could not help being still a little sceptical as to the fact of gold being distributed so regularly throughout a series of beds of quartz. It was true, in a later part of the paper, this statement was somewhat "hedged," and it was pointed out that there were irregularities, which one would have been scarcely induced to expect from the first account of what appeared to be regularly stratified beds. For himself, he could not help coupling what was said about synclinal and anticlinal beds as a certain amount of theory, and bringing it to bear upon the explanation which was suggested of these facts, viz., that the gold had been deposited contemporaneously with the quartz by the sea-water. If this were so, why was not all the gold deposited at the bottom of the sediment, by reason of its greater specific gravity? But by another part of the paper it appeared that the gold ran only in streaks, and that it seemed to be accumulated near certain crossing of these beds by other lines of quartz, which looked more like true veins. At present, therefore, he could not help saying he thought there was a good deal more to be made out. He had on former occasions visited certain localities, though not in Nova Scotia, where it was said that minerals occurred regularly throughout a stratified mass, but he had usually found such a statement to be the result of deficient observation. In a certain part of the stratified-looking mass there had been a dissemination of mineral matter, but very frequently this apparently stratified mass was nothing else but a mass of stratified material, ground and rubbed together, and existing between two walls resembling those of a regular vein; or again, that the mineral matter had been most decidedly intercalated at a period long subsequent to the original formation of the beds. He could not help thinking, in spite of all the excellent accounts which had been brought forward, that this would prove to be the real explanation of the occurrence of the gold in a great part of these Nova Scotia deposits. With regard to the second part of the question, it appeared quite clear that there was, throughout a great part of this district, a sufficiently large proportion of gold extending throughout these quartzose deposits, whether beds or veins, to pay well for mining enterprise, and the question might therefore be asked why had it not succeeded better? For a number of years, 600 or 800 men had been engaged in this work, but only a few mines had been successful, and therefore they were much indebted to Professor Hind for the valuable statistics he had brought forward, because the question seemed to be—Given that this was really a gold-containing district, was it not possible, instead of these 600 or 800 men, to employ 6,000 or 8,000, or even more, in raising gold, to the advantage of all parties concerned? Undoubtedly it ought to be so, for there was no doubt that here there was a gold-field such as was seldom to be met with; and if the proportion laid down from the statistics furnished by the Commissioner of Mines were to be depended upon, there ought to be machinery and appliances brought to bear upon these mines such as would ensure a very handsome return to capital invested in undertakings intended to last over a long series of years. This was really a point of almost imperial importance, for it appeared that, up to the present time, the resources of the country had been developed to a pitifully small extent; and no doubt that this was because the undertakings had been conducted by persons unprovided with money, or with that intelligent guidance which it might be presumed they would have had if the matter had been taken in hand by persons better provided with money, without a good supply of which nothing could be successfully carried on. He could not help remembering, when mention was made of the large quantities of ore which had been stamped or crushed in order to extract the gold, that it was not above two-thirds of the quantity which one single tin mine in Cornwall was in the habit of stamping per annum by means of its efficient machinery, worked by steam or water-power, for the purpose of extracting a small modicum of tin ore, and that showed that the work had not been undertaken upon such a scale as to render any great success probable. Again, he noticed that from the large quantities of ore raised in different places, the proportion of gold was from 1 oz. to 1 oz. 4 dwt., or even 1 oz. 16 dwts. per ton, and that in the Waverley district it was found that a proportion of 7 dwts. per ton would not yield a profit. On the other hand, in travelling through the Tyrol into Italy, a few miles from Innspruck, there was to be found a mine at Heinzenberg, at Zell in the Zillerthal, worked for gold only, a mine worked to a much greater depth than any in Nova Scotia (where the richer material would produce perhaps 10 dwts. to the ton), but where the proportion of gold present in the bulk of the ore was not more than about 2 dwts. per ton. It would have been very interesting if there had been any gentleman present, conversant with the practical details of the process by which gold was extracted, to have heard a few words upon the actual contrivances employed in this case, but it would be almost foreign to the question brought forward in the paper, the principal object of which was to show, first, that gold existed in large quantities in Nova Scotia; and, secondly, that it afforded a field for the advantageous employment of capital from abroad. In spite of the nine causes of failure which had been mentioned, it was evident that many of them would disappear the moment that large

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On gold-mining ...
Canadian pamphlets

capitalists were prepared to go into the matter, because if large companies were formed in England, they would of course employ agents familiar with the machinery and appliances requisite for successful mining, who would open workings upon a very different scale from anything which had yet been attempted. One point he might venture particularly to call attention to. A great deal of attention was given apparently, as had been well pointed out by Mr. Robinson, to the sinking of a great number of shafts. But any one familiar with mining operations must know, that sinking so many shafts in one lode, was like opening so many different mines at once, and exposed the company to such expense that it was extremely unlikely it could succeed. Again, it appeared that these shaftings and levels were mere little holes, as compared with what were called shafts in many old-established mining districts. They had been open for eight or nine years, but yet they still measured the depth only by 100 or 120 feet, or in some cases as much as 200 feet. In this country however, mines were accustomed to go by fathoms, or yards at least, and they would think very little of the depth of a shaft of 200 feet, when it came to be reduced to fathoms. Then, again, there was the question of opening the ground horizontally by drifts. It was very well known that even in copper, lead, or tin veins in this country it was useless to exceed any great depth, until by perseverance, continued over several years, a large quantity of ground had been opened, for the purpose of passing through the different lodes, and discovering what were called pipes, shoots, or by various names in different localities. Until a work of this sort had been fairly accomplished, nobody could say that a mine, whether tin, silver, lead, or still less so in the case of gold, was worth working or not. He hoped the information which had been so well put together in the paper would lead to the establishment of a better state of things than had yet been the case in the colony, and, in conclusion, begged to propose a hearty vote of thanks to Professor Hind for the paper which he had read.

The vote of thanks was passed unanimously.

At KING'S COLLEGE, London, Lectures on Mineralogy are given on Wednesday and Friday Mornings, from Nine to Ten o'clock, from October to Christmas, to which the public are admitted on paying the College Fees.

The Course commences with a description of the Physical and Chemical characters of Minerals in general.

The principal simple Minerals are next separately considered, and the readiest mode of distinguishing them described.

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JAMES TENNANT, Mineralogist to Her Majesty, 149, Strand, W.C.

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